2021

FDST205 Food Composition Analysis — A Peer Review of Teaching Project Benchmark Portfolio

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Benchmark Portfolio

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Spring 2021

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Abstract:

The purpose of this peer review of the teaching portfolio was to document and evaluate the course activities that are aimed at improving student learning in FDST205 Food Composition Analysis. This FDST205 is unique that it is offered exclusively to the students in the 3+1 International Food Science Dual Degrees Program established between the University of Nebraska-Lincoln (UNL) and Northwest Agricultural & Forestry University (NWAFU) in China. Students that enrolled in this course were a cohort of 55 sophomores in the 3+1 Food Science Dual Degrees Program. In spring 2021, the lecture part of FDST205 was offered online synchronously, while the laboratory part was offered in a hybrid model due to the international travel restriction of UNL faculty imposed by COVID-19. I worked with the NWAFU faculty and laboratory personnel remotely and collaboratively to deliver a hands-on in-person food compositional analysis laboratory on the NWAFU campus in China. This portfolio focused on the evaluation of the effectiveness of several active learning activities (i.e., case studies, in-class quizzes, questions & answers) used in the synchronous lectures, the hybrid laboratory course delivery, and the scientific writing activities embedded in the lab reports. The results show the new activities and the hybrid laboratory model introduced in Spring 2021 positively impacted students learning experience and improved their technical skills and scientific writing skills. This benchmark portfolio is an evaluation and reflection on my course goals, pedagogical practices, and student learning outcomes.

Keywords:

FDST205 Food Composition Analysis, 3+1 Food Science International Dual Degrees Program, active learning, scientific writing, hybrid laboratory course

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MEMO 1: OBJECTIVES OF PEER REVIEW COURSE PORTFOLIO

This portfolio was completed as part of the Peer Review of Teaching Project at the University of Nebraska Lincoln (2020 - 2021). The goal of this course portfolio was to revise, evaluate, and document my pedagogical practices and student learning outcomes in FDST205 Food Composition Analysis. The process of developing the course portfolio allowed me to re-examine how my course materials align with the course goals and objectives and how effective were my teaching methods. I anticipated using the course portfolio to improve my teaching practice and help to disseminate my teaching practice as publications. The data obtained from this course portfolio would also serve as preliminary results to apply for fundings that could give me the ability to generate a better designed research project.

Generally, FDST205 is offered in the Department of Food Science and Technology (FDST) within the College of Agricultural Sciences and Natural Resources at the University of Nebraska-Lincoln (UNL). **This course FDST205 Food Composition Analysis is unique in the sense that is offered to the students in the 3+1 International Food Science Dual Degrees Program (refer to 3+1 Program hereafter). The 3+1 Program is established between the FDST at UNL and the College of Food Science and Engineering at the Northwest Agricultural & Forestry University (NWAFU) in Yangling, China.** I began teaching this course in Spring 2018 and have made several revisions based on the target student bodies, student feedback, and peer evaluation. In Spring 2021, the lecture part of FDST205 was offered online synchronously, while the laboratory part was offered in a hybrid model due to the international travel restriction of UNL faculty imposed by COVID-19. I made some major revisions to the courses, including the addition of case studies, the replacement of think-pair-share with Q&As in the online lecture, redesign of the lecture topics, and the addition of the scientific writing training in the laboratory section.

This portfolio provides a broad overview of the entire course including course goals, teaching pedagogy, student learning outcomes, and student assessments, etc. This course portfolio documents my teaching endeavors and student learnings in the 3+1 Program. It can be used for the assessment of the 3+1 Program by both UNL and NWAFU.

MEMO 1: DESCRIPTION OF THE COURSE

COURSE BACKGROUND

FDST205 Food Composition Analysis is a 200 level undergraduate course offered by the Department of Food Science and Technology at UNL. This course covers the chemistry and structures of major food constituents and the analytical methods for the determination and characterization of major food constituents. Specifically, the course covers the application of quantitative and qualitative physical, chemical and instrumental methods used for the analysis of the major food constituents, as well as the evaluation of methods and interpretation of results. In this course, the students will learn to identify the appropriate methods for compositional analysis of foods and characterization of foods based on the investigation purpose, either nutrition labeling, quality control, product development, or scientific research.

This course is a 3 credits course with 32 hours of lecture and 32 hours of laboratory. Students are required to take CHEM109 General Chemistry I, CHEM110 General Chemistry II, and FDST101 Introductory Food Science or FDST131 The Science of Food before taking this course. FDST205 Food Composition Analysis lays the foundation for many other courses in the Department including FDST448 Food Chemistry, FDST449 Food Chemistry Laboratory, FDST458 Advanced Food Analysis, FDST403 Food Quality Assurance, FDST412 Cereal Technology, FDST413 Baking Technology, FDST414/814 Egg Processing from Science to Technology, FDST420 Fruit and Vegetable Technology, and FDST4298 Dairy Products Technology.

COURSE OFFERING FOR 3+1 PROGRAM AND COURSE ENROLLMENT

It is unique that my FDST205 is offered exclusively to the sophomores in the 3+1 Food Science Dual Degrees Program. The 3+1 Program between UNL and NWAFU began in 2015 with the admission of 50-60 students to NWAFU per cohort. Students attend NWAFU for their first three years and UNL for their fourth year, meeting the degree requirements of the Food Science Program in both universities and graduating with BS degrees from both programs. The 3+1 program has a fixed curriculum compared to the regular FDST program at UNL. All 3+1 students take FDST205 as their first Food Science major course in their sophomore years, so it is a very important fundamental course for all future FDST courses. Approximately fifteen classes (including technical electives) are taught by UNL faculty at NWAFU campus in China, and students come to UNL for their senior year where they take six core Food Science classes, technical electives, and other courses to fulfill UNL's degree requirements. Before the pandemic, I traveled to China every semester to offer FDST205 in-person at the NWAFU campus. There are typically 55 to 65 students enrolled in this class each semester. In Spring 2021, 55 sophomores in the 3+1 Program enrolled in FDST205.

INSTRUCTIONAL MODALITY IN SPRING 2021

Due to the international travel restriction imposed by COVID-19, FDST205 was offered online in Spring 2021. **The lectures were taught by distance synchronously**

using Zoom. The laboratories were taught in a hybrid model. I pre-recorded instruction videos to be played at the beginning of laboratory sections. After watching the instruction videos, students performed the hands-on experiment with the guidance of NWAFU faculty members in the laboratory space on the NWAFU campus in China. Course syllabus is provided in **Appendix A**.

COURSE OBJECTIVES

- Understand and apply critical principles of sample collection, sample preparation, and data evaluation associated with food analysis.
- Understand the chemical properties of major food constituents, including water, proteins, fats, carbohydrates, and minerals.
- Identify the principles, purposes, and applications of techniques to chemically and instrumentally analyze major food constituents.
- Discuss typical analyses associated with quality management of an individual food product, from raw ingredients to final products.
- Identify appropriate methods for chemical and physical characterization of major food constituents.
- Provide chemical and instrumental hands-on laboratory experience for students in the Food Science curriculum while training them to interpret data and writing the laboratory reports scientifically.

COURSE LEARNING OUTCOMES

- Obtain representative samples of foods and ingredients from bulk lots, and prepare them for analysis.
- Understand the basic chemistry and structures of water, proteins, lipids, carbohydrates, and minerals in foods.
- Demonstrate an understanding of the basic scientific principles associated with each type of food compositional analysis.
- Identify the appropriate methods of analysis to be used based on the investigation purpose (nutrition labeling, quality control, product development, or scientific research) and different food matrices.
- Understand and evaluate the advantages and disadvantages of different analysis methods that can be applied to a specific food.
- Quantitatively express how the strengths and concentrations of acid and base affect the pH and titratable acidity of foods.
- Perform chemical analysis of major food constituents in the lab.
- Analyze experimental data, construct visual representations of data, and write technical lab reports that meet scientific journal standards.
- Improve scientific writing skills.

EXPLANATIONS OF HOW THIS COURSE FITS WITH OTHERS IN THE DEPARTMENT AND THE UNIVERSITY

In the 3+1 Program, students take FDST205 as their first major course, so it is a very important fundamental course for all future major courses. The case studies and examples of real-world problems used in this course provide students with opportunities to understand how quality management works in the food industry. The hybrid laboratory section provides the hands-on opportunity for students to learn the proximate analysis of foods and other chemical and instrumental food analysis methods. The writing of lab reports trains the students on how to interpret the experimental data and write lab reports scientifically. Students learn basic scientific communication skills through guided lab report practices. This course promotes students' interest in the Food Science major and paves the solid foundation for future Food Science major courses. It also helps the students secure internships and future careers in the food industry.

MEMO 2: TEACHING METHODS/COURSE MATERIALS/COURSE ACTIVITIES

TEACHING METHODS

In Spring 2021, the lecture part of FDST205 was taught synchronously online using Zoom, and the laboratory part was taught in a hybrid model through the collaboration with NWAFU faculty and personnel in China.

Synchronous Online Lecture:

The lecture schedule was mostly two 40-minute online classes per week with a few weeks being taught as three 40-minute classes. The students have not taken biochemistry and food chemistry before entering my course, so they are lack of the background knowledge which are required for learning food analysis. Thus, the first half of the semester primarily focused on lecture-based instructions due to the limit of time and lack of background knowledge.

I interspersed the lecture with 1 to 3 questions and answers (Q&As) to engage the students actively. Based on my experience from the distance delivery in Fall 2020, I can maintain a very active classroom using frequent Q&As in the distance learning format. The live lectures were recorded and made available to the students for reviewing purposes. Student learning outcomes were routinely evaluated using in-class online quizzes as well as examinations.

Hybrid Hands-on Laboratory:

Laboratory experience is a critical component of this course. The laboratory course was delivered in a hybrid model in collaboration with the NWAFU counterpart to provide students hands-on laboratory experience. Students are expected to learn the common laboratory techniques used in food compositional analyses. Also, they are expected to learn how to perform data analysis, construct visual representations of data, and write technical lab reports that meet scientific journal standards.

For each laboratory, I pre-recorded the “pre-laboratory”, “in-laboratory”, and “post-laboratory” instruction videos. The in-laboratory videos explain how to perform the hands-on experiment and are required to be watched at the beginning of hands-on laboratory sections at the NWAFU campus in China. Students performed the hands-on experiment with the guidance of NWAFU faculty members in the laboratory space at NWAFU. The pre-laboratory videos cover the background knowledge of the lab topics and the post-laboratory videos cover the data processing and four scientific writing training activities. This unique hybrid laboratory model allows students to practice hands-on experiments without the presence of the UNL instructor. The learning effectiveness was evaluated using lab reports and a portion on the final exam (25 points out of 150 points).

COURSE MATERIALS

All course materials are made available on both the Canvas course page and a class QQ message group (a APP that is commonly used among Chinese students) at

least two days prior to the materials were covered. The class message group was used to ensure all the students residing in China have access to course materials in time.

Lecture Materials:

The lecture course materials include lecture PowerPoint slides, textbook readings, additional readings, and educational videos. Emphasis was placed on learning and understanding the lecture materials in the PowerPoint slides. The textbook "Food Analysis" 5th Edition by S.S. Nielsen is used as a reference for the course. The textbook readings were required because the textbook has an excellent summary of the advantages and disadvantages of the common food analysis technique. In addition, the end-of-chapter study questions on the textbook were optional to complete but were helpful for students to fully understand the course contents and to prepare for the quizzes and exams.

Laboratory Materials:

The laboratory course materials include pre-laboratory materials (lab manuals, lab instruction videos & PowerPoint slides), in-laboratory materials (lab protocol videos), and post-laboratory materials (lab reports, scientific writing activity videos & PowerPoint slides, extra reading materials, and sample student lab reports). Figure 1 provides an example of the materials used in laboratory 2. The textbook "Food Analysis Laboratory Manual" 3rd Edition by S.S. Nielsen is used as a reference for the laboratory part.

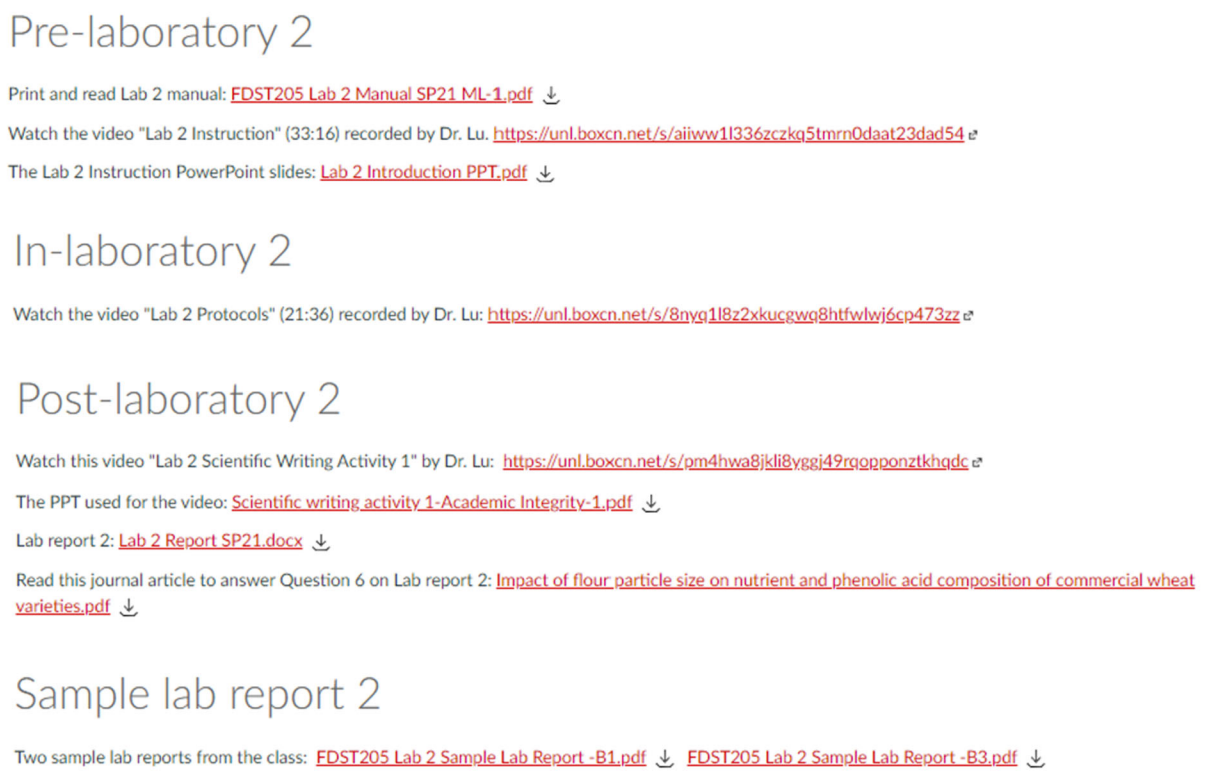

Figure 1. Example of Laboratory 2 Course Materials

COURSE ACTIVITIES

The pre-assessment and post-assessment were used to measure student growth over the semester time and to help the instructor refine the instruction plan in the future. These two assessments did not count towards students' total grades.

Two case studies were added to FDST205 in Spring 2021 to make the course more applicable. Case studies helped the students relate and apply the course content to real-life situations in the food industry. Students were expected to learn how to apply food analysis knowledge and techniques to the quality management of different food products from raw ingredients to final products. Discussions on case study questions were completed in class and case study reports were written in groups outside of the class. Students' performance was assessed based on the quality of case study reports.

Questions and Answers (Q&As) were used to replace the traditional think-pair-share activities in synchronous online lectures. Students usually worked on their own devices during synchronous lectures, so the Q&As were more efficient to keep the students engaged and active in the online class. In a typical 40-minute lecture, 1 to 3 Q&As were used to get immediate feedback on student understanding of the class material. This instant feedback allowed students to better understand the concepts taught in this course.

Four 10-minute in-class quizzes were given throughout the semester through Canvas during synchronous class time. The quizzes were open-book multiple choices and true-or-false questions. Students were required to work independently and kept the camera on Zoom during the quizzes. The schedule of the quiz was specified in the schedule section of the syllabus (**Appendix A**). The content of each quiz was based on the associated PowerPoint slides and assigned textbook chapters. Quizzes were intended to make sure students benefit from the class session and motivate students to review the class materials regularly.

Four scientific writing training sections were provided from the 2nd to 5th weeks of the laboratory schedule as the post-laboratory exercises. Both pre-recorded videos and PowerPoint slides were made available to the students on the following topics:

- Topic 1 Academic integrity;
- Topic 2 Search for scientific publications and the use of citations in APA style;
- Topic 3 How to construct and label figures using the Excel program;
- Topic 4 How to construct and label tables using the Excel program.

Eight scientific writing practice sections were embedded in each of the 8 lab reports. Both the scientific writing and the English writing skills were evaluated using specific grading rubrics (**Appendix B**). I graded the proper discussion of data and the visual presentations of data. A student teaching assistant (TA), minoring in English major at UNL, graded the English writing elements and the proper use of citations. Students received feedback on their paragraph structure, grammar, sentence structure, punctuation, in-text citation styles, reference list, labeling of tables and figures weekly.

Students were expected to improve on the following lab reports after receiving the comments.

Lab reports: A total of 8 lab reports were required for each of the 8 hybrid hands-on laboratory exercises. Students submitted a group lab report one week after the completion of the lab exercise. Students learned to write about quantitative and qualitative analysis of food products, to interpret the experimental data generated, and to construct figures and tables using a scientific style.

RATIONALE FOR TEACHING ACTIVITIES

I am committed to providing students an active, interesting, and applicable learning experience through the applications of various active teaching activities. The case study is a type of problem-based learning, which promotes the development of analytical skills and helps the students connect between specific lecture topics and real-world applications. Case study reports are completed as if the students were responsible for the quality management of a particular food product at the manufacturing site for a food company. The regular in-class quizzes motivate the students to review the class materials regularly. Students complete the short online quiz on their own electronic devices during class time. I review their responses and provide students immediate feedback on their learnings. Q&A activities are frequently used in the lecture to keep students engaged in the class and to clarify the confusing concepts in the course materials.

Effective communication is an important professional skill that allows food scientists to communicate scientific findings or project results to audiences with diverse scientific backgrounds such as consumers, supervisors, and other scientists. Mastery of effective scientific writing requires continuous development throughout an undergraduate STEM program. The current 3+1 Food Science Program curriculum requires 3+1 students to take four integrated English classes, two college-level English writing classes, and one technical communication class. However, those classes are meant to develop student's English proficiency and English writing skills. It requires complementary support to develop student's understanding of the conventions and elements of scientific writing. These knowledge gaps make it challenging for students, especially non-native English speakers, to effectively transfer the English writing skills acquired in their communication courses into scientific lab reports. Therefore, it is critical to teach students the key components of scientific writing and provide students with chances to practice their scientific writing skills using lab reports.

ILLUSTRATION OF CHANGES FROM PREVIOUS YEARS/SECTIONS

A. Case studies were added to FDST205 in Spring 2021 for the first time. The two case study topics are "production decision based on moisture content" and "quality defects related to fat characterization". An example of case study 1 is shown in the below:

Case Study 1 Production Decision Based on Moisture Content

Situation:

- *A new low-moisture, cereal product is being produced in the Southern United States.*
- *Product is packed in large containers (3+00 lb./box) at a target moisture of 2.9%.*
- *Product in large containers is shipped to another packaging site for packaging into product for sale to consumers.*
- *When the product from one lot of product is received at the packaging site, the moisture content is 3.2%.*
- *Policy at the packaging site is to ideally run at 2.8% moisture and shut down the packaging line at above 3% moisture.*
- *METTLER TOLEDO instruments (i.e., rapid moisture analyzer) were used at both the plant processing the product and at the packaging facility.*

Case Study Source: *Dr. Suzanne Nielsen at Purdue University*

Video Resource: *Here are some videos to help students understand how is cereal made and how is rapid moisture analyzer calibrated.*

- *"Frosted Cereal - How It's Made",* https://www.youtube.com/watch?v=a0Y5J_pgiFY&t=21s
- *"How It's Made – Cereal"* https://www.youtube.com/watch?v=HPpMV_vcVEg&t=215s
- *"How to calibrate a moisture analyzer"* https://www.youtube.com/watch?v=uKUkgNEVfM0&t=22s

Case study report questions:

1. *What likely caused the problem? (2 pts)*
2. *What questions will you ask? (2 pts)*
3. *What will you do? (i.e., will you shut down the packaging lines? What will the company do in the future?) (2 pts)*
4. *Why is moisture analysis important in cereal products? (2 pts)*

References (0.5 pt)

B. Q&As were added to the online FDST205 in Spring 2021 to replace the in-person Think-Pair-Share activities. Two examples of these modifications are shown in Figure 2.

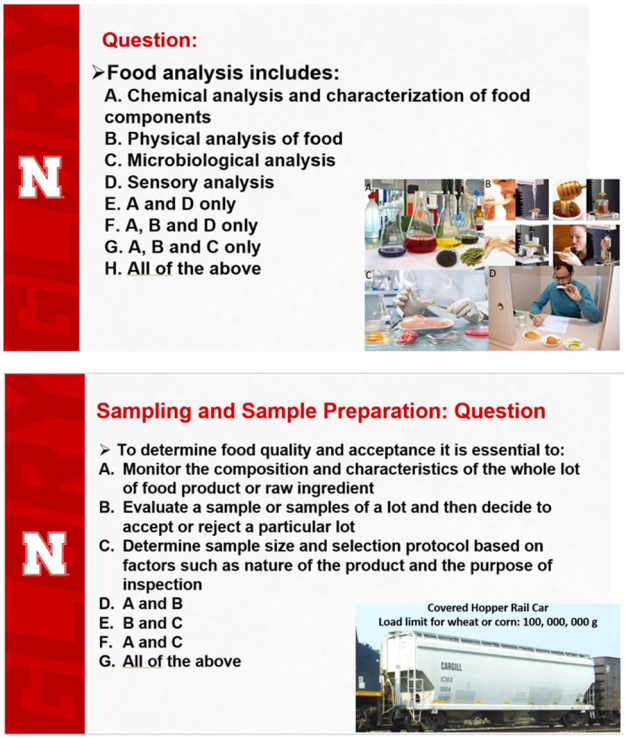

Figure 2. Examples of Q&A activities used in the synchronous online lectures.

C. Four scientific writing training activities were added as the post-laboratory exercise of FDST205 in Spring 2021 for the first time.

I prepared four scientific writing training instructions (video instruction and PPT slides), which were provided to the students during the first half of the laboratory session. The topics of the scientific writing training include academic integrity, use of databases, citations in APA styles, and construction of tables and figures in the Excel program. The example of part of the PowerPoint slides used in “Scientific Writing Training Activity 2 Search for Scientific Publications, Citation, and APA Styles” is shown in Figure 3.

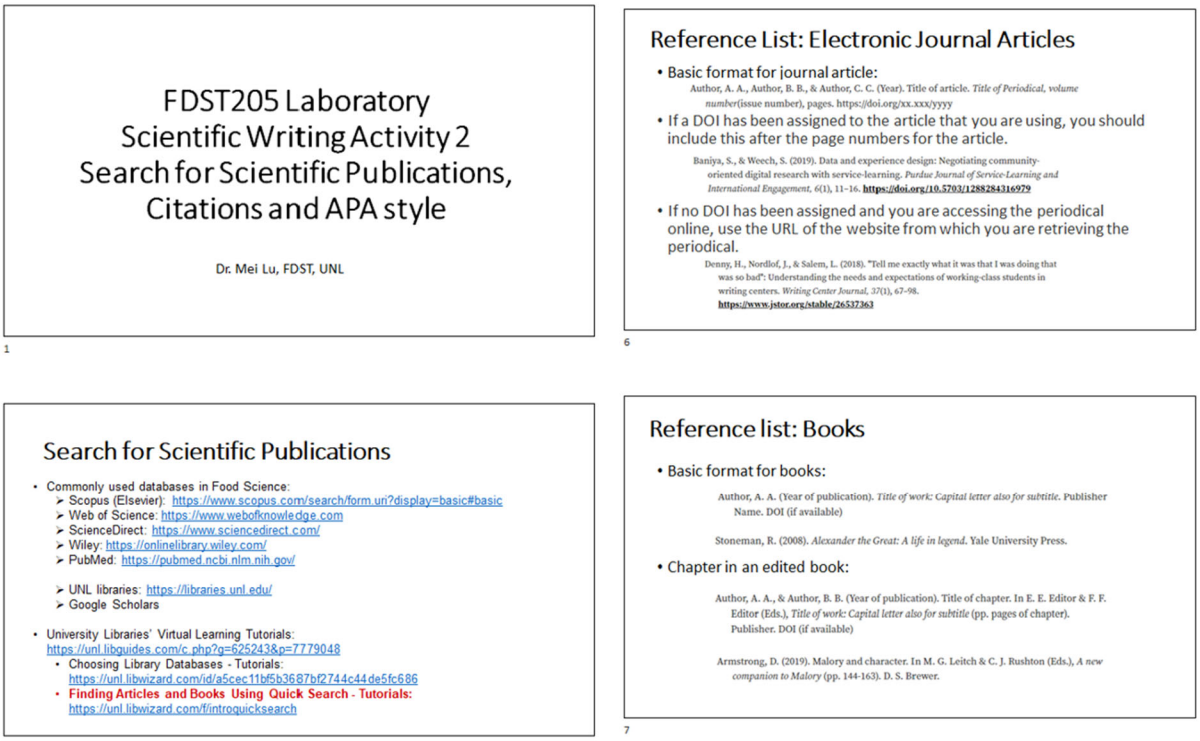

Figure 3. Examples of scientific writing training slides used in the post-laboratory exercise.

D. Eight scientific writing practice activities were added to the 8 lab reports of FDST205 in Spring 2021 for the first time.

Each lab report is worth 18 points in total. The technical part of the lab report is worth 15 points and the scientific writing part is worth 3 points. The grading rubrics in the scientific writing section are provided in **Appendix B**. Three examples of the scientific writing practice questions are shown below:

> ***Example 1: Lab report 2 Question 6.*** *Read the journal article "Impact of flour particle size on nutrient and phenolic acid composition of commercial wheat varieties". Summarize the scientific findings on how particle size affects the crude fat content analysis. Explain why the particle size of the sample impacts the crude fat content analysis. Add this journal article as your reference at the end of the lab report in the following format:*
>
> *Author, A. A., Author, B. B., & Author, C. C. (Year). Title of article.* Title of Journal, volume number*(issue number), pages. https://doi.org/xx.xxx/yyyy (Format: Title of Journal and volume are both italicized. The hanging indent is 1.27 cm or 0.5 inches)*

> ***Example 2: Lab report 3 Question 10****. How do the ash contents of the white and whole wheat flours compare? What are the reasons for any differences that exist? Use the journal article "Understanding whole-wheat flour and its effect in bread: A review"*

provided to help answer this question. Add the article as an in-text citation and in the reference list using APA style.

Example 3: Lab report 5 Question 6. *Construct a table and a bar graph to show the average protein % and average dietary fiber % in three types of commercial flours using the raw data provided below. Be sure to include standard deviations in the table and as the error bars in the bar graph. Watch the post-laboratory video "Scientific Writing Activity 4" to learn how to construct tables and figures. All-purpose flour is a versatile and general use refined wheat flour. All-purpose flour is suitable for all types of baked goods such as bread, biscuits, pizza, cookies, muffins, etc. Please explain why all-purpose flour has a lower dietary fiber % than whole wheat flour.*

Table 1. Raw data of protein concentrations in three types of commercial flours.

	Types of Commercial Flours		
Protein%	*Whole wheat flour*	*All-purpose flour*	*Cake flour*
Replicate 1	*13.33*	*10.36*	*7.54*
Replicate 2	*13.00*	*10.08*	*6.88*
Replicate 3	*12.38*	*9.87*	*7.25*
Dietary fiber%	*Whole wheat flour*	*All-purpose flour*	*Cake flour*
Replicate 1	*10.00*	*2.66*	*0.00*
Replicate 2	*9.80*	*1.89*	*0.00*
plicate 3	*10.30*	*2.40*	*0.00*

MEMO 3: ANALYSIS OF STUDENT LEARNING

NOTE: At the time of submission of this peer review teaching portfolio, the course instruction is still ongoing. The students in the 3+1 Program study in China for the first three years and follow the academic calendar at NWAFU in China. The class instruction and evaluations are expected to be done by July 2nd, 2021. The following analysis of student learning was based on the data collected from the midterm exam, post-midterm course evaluation, first 3 quizzes, 1 case study report, 8 lab reports, and the optional pre-assessment quiz.

Of the 55 students enrolled in FDST205 in Spring 2021, all 55 students gave permission to use their assessment information and grades in this portfolio.

ANALYSIS OF PRE-ASSESSMENT AND POST-ASSESSMENT

The pre-assessment was conducted during the first week of this course. It was used to evaluate the student's background knowledge and to measure student growth over the semester time. Results from the optional pre-assessment are listed in Table 2 below. The results of the post-assessment will be collected at the end of June 2021 and will be compared with the pre-assessment to evaluate learning outcomes.

Table 2. Results of the pre-assessment quiz collected during week 1 of the course. The response rate was 92.7% (51/55 students).

Questions	Pre-assessment
Which of the following is a disaccharide? A. Sucrose; B. Glucose; C. Starch; D. Fructose.	76% correct
	24% incorrect
Water activity is a measurement of the moisture content in foods. True or False	73% correct
	27% incorrect
Which one is a minor component in foods? A. Water; B. Carbohydrate; C. Vitamin; D. Protein; E Lipid.	90% correct
	10% correct
Which type of microorganism can grow in food having a water activity of 0.95? A. Yeast; B. Bacteria; C. Molds and fungi; D. No microbial growth.	37% correct
	63% incorrect
What is the pH value of 0.02 M NaOH solution? A. 1.7; B.7.3; C. 12.3; D. 15.7.	92% correct
	8% incorrect
	12% correct

What types of material is the bomb sampler used to sample? A. Granular solid; B. Powdery solid; C. Liquid; D. Gas.	88% incorrect
All of the following conditions must be met for a substance to be successfully measured by titration, EXCEPT_____. A. The reaction must go to completion; B. The reaction must be very fast; C. The reaction must not have side reactions; D. The reaction must be in equilibrium	18% correct 82% incorrect
Lard, butter, and cream are rich sources of _____. A. trans fatty acids; B. saturated fatty acids; C. monounsaturated fatty acids; D. polyunsaturated fatty acids	65% correct 35% incorrect
Alpha-helix, random coil, and β-pleated sheet are examples of the _____ structure of a protein. A. primary; B. secondary; C. tertiary; D. Quaternary.	61% correct 39% incorrect
This question is designed to test your knowledge of plagiarism and referencing in scientific writing. Which of the following should you NOT do when paraphrasing? A. Use your own language and style. B. Change just one or two words in a sentence. C. Restate information and ideas accurately. D. Reference the source.	90% correct 10% incorrect

The average score of the pre-assessment quiz is 57%, ranging from 20% to 100%. The score distribution of the pre-assessment quiz is shown in Figure 4. The results show that students enter this course with limited background knowledge on biochemistry, food chemistry, and food microbiology. According to the pre-assessment results, my instruction was adjusted to introduce more basic chemistry of major food constituents before lecturing the food compositional analysis techniques.

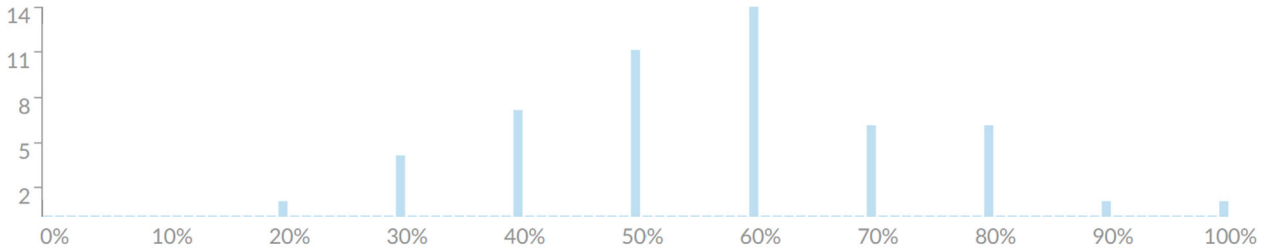

Figure 4. The score distribution of the optional pre-assessment quiz.

IN-CLASS QUIZZES IMPACT STUDENT LEARNING EXPERIENCES

As an instructor, my main responsibility is to motivate my students to learn and review the lecture materials regularly rather than cramming before the exam. There are 2 quizzes before the midterm exam and 2 more quizzes in between of midterm and final

exam. The first two quizzes are conducted at the beginning of the lecture and covered previous lectures' contents. The last two quizzes are conducted at the end of the lecture and cover the contents of the day. Students were aware of the quiz schedule and were anticipated to review the corresponding course materials. Note that quiz 4 has not been completed yet at the time of submission of this portfolio.

The average scores for the first two quizzes are both 79% and the average score for quiz 3 is 91% (Figure 5). Two major reasons contributed to the significant increase of quiz 3 scores. First, quiz 3 was conducted at the end of the lecture and it covered the contents of the day. It shows that students were more focused and engaged in the course materials when they knew they would be tested at the end of the lecture. Second, students gradually learned how to better learn in this course after midterm exam.

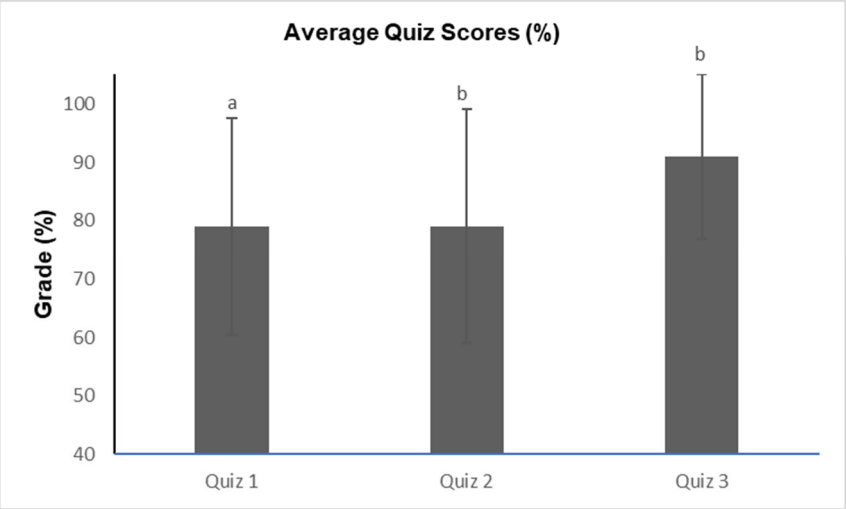

Figure 5. The average quiz scores of quiz 1 to quiz 3. Fischer's LSD method was used to compare the differences in the scores. Different lower case letters represent significant differences, $P < 0.05$.

To test the predictive power of performance on the quizzes, students were divided into five groups based on their average quiz percentiles, i.e., 0-20%, 20-40%, 40-60%, 60-80%, and 80%-100% percentile. As shown in Figure 6, students who were in the upper 60-80% and 80-100% percentiles had higher grades on the midterm exam. Students who did well on quizzes scored higher on the midterm exam. The value of the quizzes was further highlighted by a student's comment:

"The quiz is the reason why I will keep on learning."

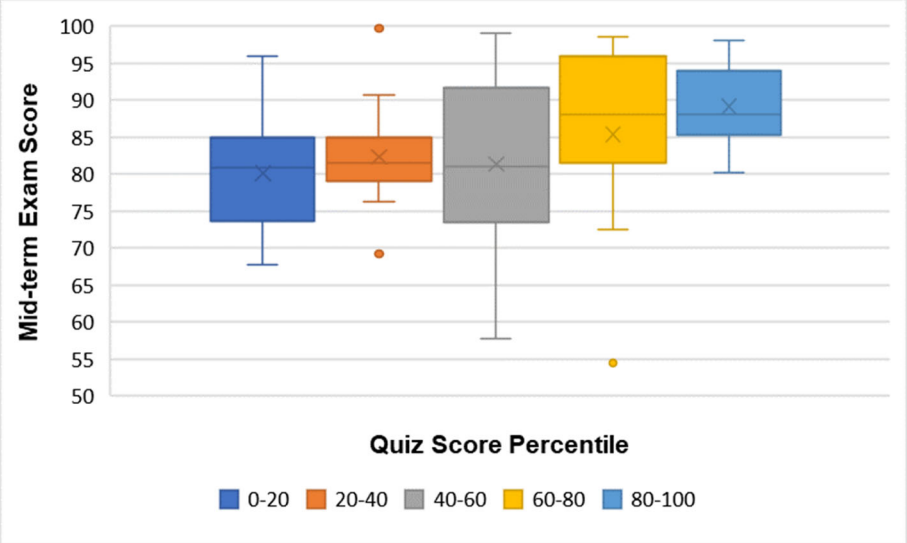

Figure 6. Comparison of the midterm exam grade relative to the student's performance on the quizzes (calculated as the average of the first 3 quizzes).

CASE STUDY RELATES THE CONCEPT TO REAL-WORLD APPLICATIONS

The case study reports demonstrate a comprehensive competence in food quality control and food analysis. One example of a student case study report is attached in **Appendix C**. On the course evalution, 100% of the students strongly agreed and agreed that case studies helped them apply the knowledge to real-world problems in the food industry (Figure 7).

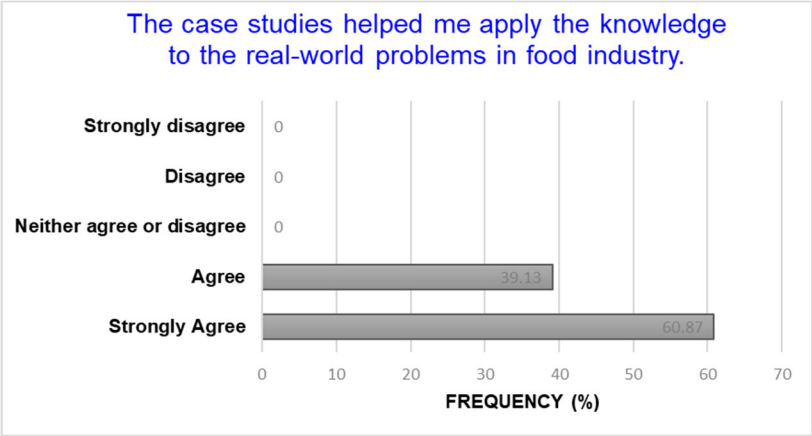

Figure 7. Students' perception of the effectiveness of case study. The response rate of the course evaluation is 45/55 (83.64).

Since there are 55 students enrolled in the course, the case study reports were completed as the group works. One student also commented on the value of teamwork:

"I have a chance to do a teamwork with my partners, if we don't have this case study, maybe I will never work with such wonderful persons."

SCIENTIFIC WRITING ACTIVITIES IMPROVE THE STUDENTS SCIENTIFIC COMMUNICATION SKILLS EFFECTIVELY

Through 8 weeks of continuous training, my student TA and I have both noticed a positive change in the student's discussion and presentation of experimental data, understanding of citations in APA style, and general English writing skills. The student TA has a minor in English and has been trained to learn the proper use of citation styles since Fall 2020. The TA usually finished grading and commenting on the scientific writing section within 3-4 days of the submission of the lab reports. I typically provided comments on the proper use of technical terms, figures, and tables, and the discussion of results within 4-6 days of the submission of lab reports for the first 4 lab reports. Students were able to see our comments and correct the mistakes before the due date of the following lab reports. As shown in Figure 8, the average grades (%) of the scientific writing section increased toward the end of the laboratory course. Fischer's LSD test shows that grades of the scientific writing section on lab reports 7 and 8 were significantly higher than lab report 1 (not labeled in Figure 8). Results show that encouraging students to practice the scientific writing skills throughout their 8 weeks of lab reports allowed them to notice their frequent mistakes and improve their scientific writing skills over the semester.

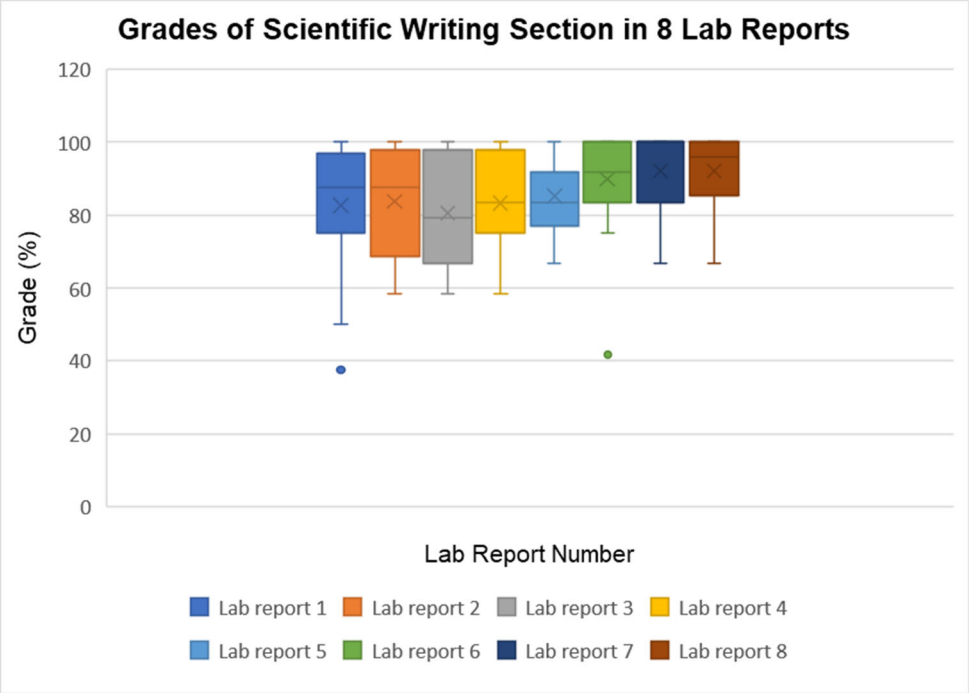

Figure 8. Box plot of grades (%) of scientific writing practice sections on the 8 lab reports.

The course evaluation results (Figure 9) show that the scientific writing activities were well-received by the students. 97.83% of students felt that they learned how to write in a scientific style and they improved their scientific writing skills. 95.98% of students strongly agree and agree the four scientific writing training helped them understand the basic elements of scientific writing. 93.48% of students responded that the feedback and comments they received on the lab reports helped them improve their scientific writing skills within a short period of time. 95.66% of students strongly agree and agree that they learned how to review and cite scientific papers.

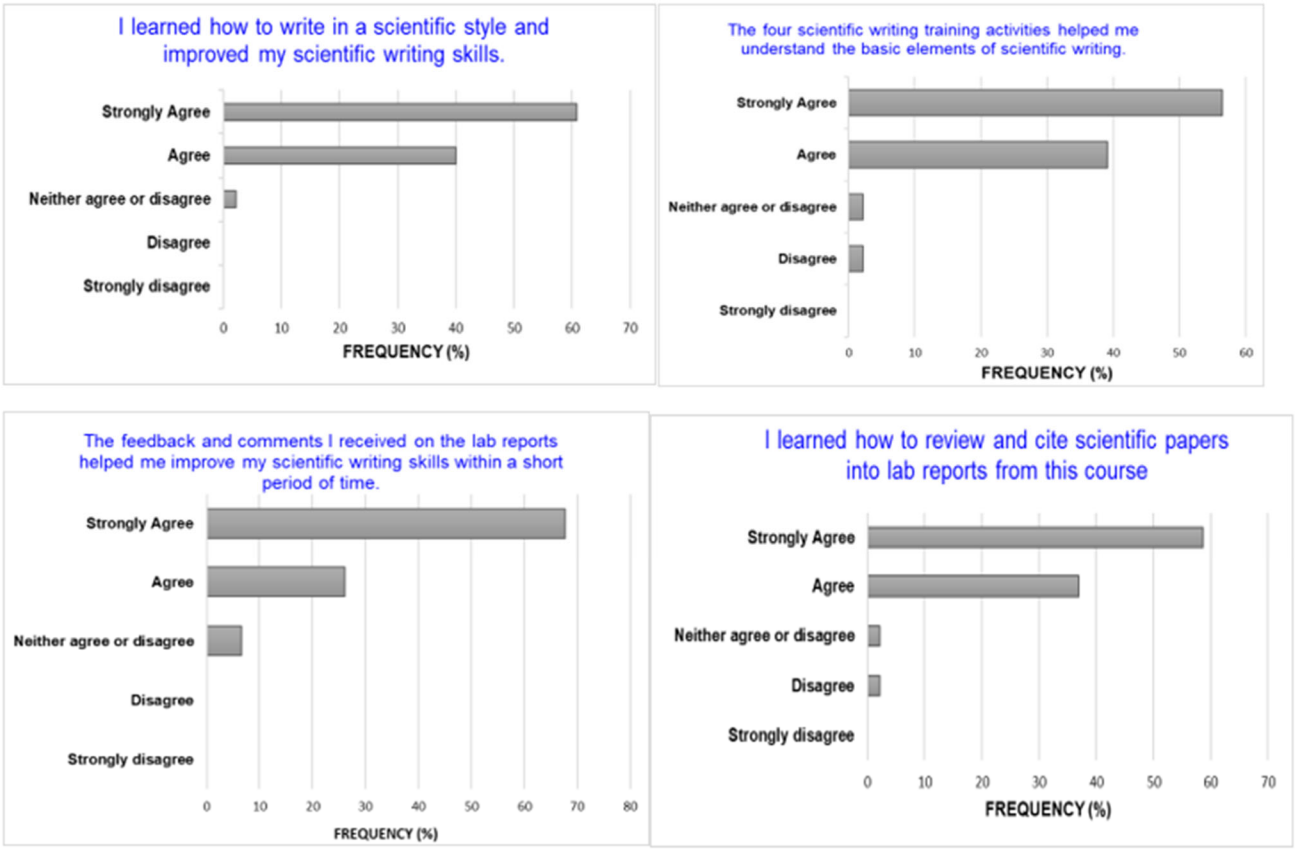

Figure 9. Scientific writing training taught and improved students how to communicate scientifically. The response rate of the course evaluation is 45/55 (83.64).

We observed that the proper use of in-text citations and references in APA style was a difficult concept for students to grasp. However, after the first few weeks of the semester, we noticed a drastic improvement amongst the students in terms of using APA citations correctly.

The student TA also commented on the English writing skills:

"*Most of these students used written English correctly, however, the language can be tricky when it comes to starting a sentence correctly, avoiding run-on sentences, and interchanging words. I noticed that many words had the correct meaning in retrospect, but they weren't the best word to use in that situation.*

Throughout my comments and conversations with students, I noticed an improvement in their sentence strength and structure, as well as their word choice."

The following comments are the responses from the post-midterm course evaluation about the scientific writing activities. These positive responses suggest and demonstrate that this teaching method and teaching activity were extremely helpful to the students.

Student 1 commented: "*The feedback is very useful to refer to when I do the lab report next time. Also I can know the aspects I should improve*."

Student 2 commented: "*In the lab, each person in my group has the chance to do some steps and what's more the most important thing after that is the group-talking about the research paper. It's really a great engagement in the assignments and the projects*."

HYBRID LABORATORY MODEL PROVIDED VALUABLE HANDS-ON EXPERIENCE FOR THE STUDENTS IN THE 3+1 PROGRAM

This hybrid laboratory model was a special arrangement for the 3+1 program during the COVID-19 pandemic. To provide students hands-on laboratory experience, I worked with the NWAFU faculty member and laboratory personnel collaboratively to deliver the in-person food compositional analysis lab exercises. Students completed very high-quality lab reports in this course (**Appendix D**). All the students strongly agreed and agreed that the hybrid laboratory effectively helped them understand the principles of laboratories and develop the laboratory techniques (Figure 10).

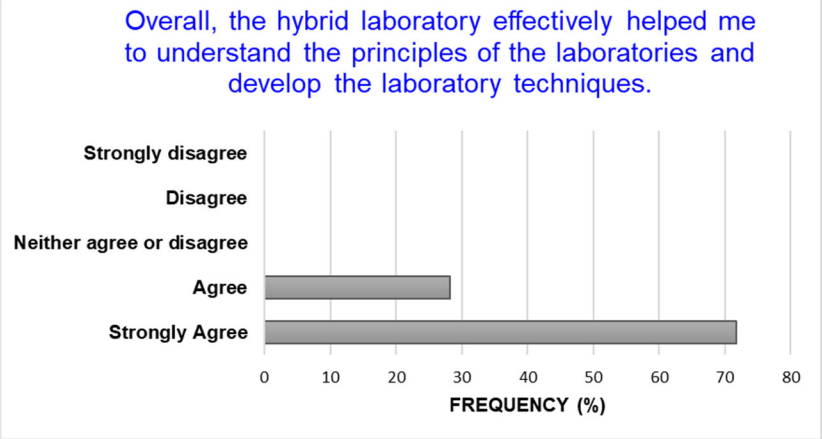

Figure 10. The hybrid laboratory model provided valuable hands-on laboratory experience to the 3+1 students.

ANALYSIS OF EXAM GRADES

The average grade of the midterm exam was 83.69 points and the median grade was 83.5 points. The highest grade was 99.75 points. Among the 55 students enrolled in FDST205, 13 students (23.6%) received grades above 90 points and 26 students

(47%) received grades between 80 and 89.99 points (Figure 11). As mentioned previously, students who did well in the quizzes also scored higher grades in the midterm exam. The final grades for the courses will be available at the beginning of July 2021 when all the instructions are completed.

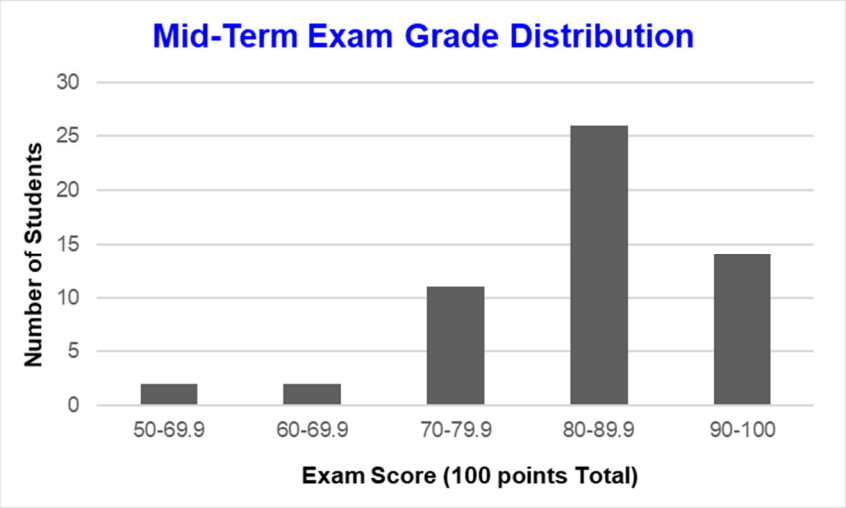

Figure 11. Histogram of the midterm grade distribution.

GENERAL STUDENT COMMENTS ON COURSE EVALUATION.

The majority of the students think that the course activities and the learning tools promoted their learning and interest in the subject (Figure 12).

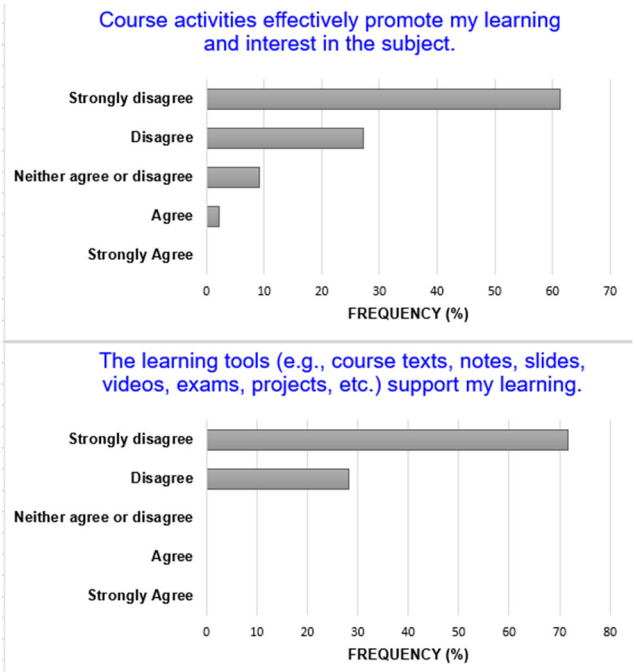

Figure 12. Student perception of general questions on the course activities and learning tools.

Below are the highlights of general student comments:

Student A commented: *“Course learning materials and tools are useful.”*

Student B commented: “The feedback told me what I should pay attention to next time and help me modify my answer.”

Student C commented: “Everything is perfect. I can know what I should learn and remember exactly.”

Student D commented: “Experimenting by myself will let me learn a lot.”

Student E commented: “This course is our first course about the major, so it's very challenging to learn this course well.”

SUMMARY: REFLECTION ON THE COUSE

Future directions to improve the course:

- Revise the case study into a semester-long project.
- Invite one or two independent assessors (preferably faculty at FDST) to assess the students' lab reports at entry (Lab report 1&2) and exit points (Lab report 7&8) to better evaluate the students' growth.
- Provide feedback weekly through PowerPoints or videos at the beginning of the laboratory course to help guide students along.
- Recruit more student TAs to facilitate all the grading works.
- Provide review sessions before each exam.
- Modify and improve the lecture slides.

In summary, the case studies, in-class quizzes, Q&As, the hybrid laboratory course delivery, and the scientific writing activities profoundly impacted students learning experience and improved their technical skills and scientific communication skills. The responses from the post-midterm course evaluation show that this course is well-received by the students.

This benchmark portfolio helped me to document and reflect on my course goals, pedagogical practices, and student learning outcomes. I gained valuable experience in documenting my teaching and analyzing student learning outcomes while compiling this course portfolio.

APPENDICES

APPENDIX A. COURSE SYLLABUS

FDST 205 Food Composition and Analysis

3 Credits, Spring 2021

INSTRUCTOR:

Dr. Mei Lu, Ph.D.

Assistant Professor of Practice

Department of Food Science and Technology

University of Nebraska-Lincoln

Email: mlu4@unl.edu

Homepage: https://foodsci.unl.edu/lu

Location: Working from home in Gilbert, Arizona in the U.S., but available via email, Zoom, and QQ.

Office hours: Dr. Lu will offer 30 minutes office hours on six Saturdays during the semester*. Dr. Lu will answer students' questions through Zoom using the Zoom link below. Refer to the "FDST205 Lecture Schedule Spring 2021" for the detailed schedule.

**Note: All the dates and times in this syllabus refer to Beijing time.*

TEACHING ASSISTANTS:

Nathan (Yuchu) Ma is a graduate TA from the Department of Food Science and Technology at UNL. He will assist in grading some of the assignments. Please contact Nathan at nathanchu@huskers.unl.edu if you need assistance.

Madyson DeJoy is an undergraduate TA from the College of Journalism and Mass Communications at UNL. She has a minor in English. She will grade the English writing skills and scientific writing skills of the lab reports. Please contact Madyson at madydejoy@gmail.com if you need assistance.

INSTRUCTIONAL MODALITY:

Online Lecture: The lecture part will be taught by distance synchronously using Zoom. I am committed to making this course valuable to you and for you to participate in the live class sessions. You are expected to have your camera turned on during the class sessions, and be identified on your picture by first (English name or Pinyin) and last name on Zoom.

Zoom Meeting ID: 932 7112 9710

Passcode: FDST205

Join Zoom Meeting:

https://unl.zoom.us/j/93271129710?pwd=MnJ3eTB2dkQxb3BubUw2Ky9zaVNMQT09

Students can watch the Zoom recordings of live lectures to review the course materials. Dr. Lu will update the Zoom recording links one day after the completion of each lecture using this link https://docs.qq.com/sheet/DY2ttZFJteHRzdkV4?tab=BB08J2&ADUIN=517688094&ADSESSION=1616344606&ADTAG=CLIENT.QQ.5689_.0&ADPUBNO=26981

Hybrid Laboratory: There are eight 4-hour laboratory exercises. In each of the labs, there will be pre-laboratory, in-laboratory, and post-laboratory videos/activities to complete. The pre-laboratory video covers the background knowledge of the lab topics. The in-laboratory video explains how to perform the hands-on experiment and is required to be watched at the beginning of laboratory sections at the NWAFU campus in China. One faculty member from NWAFU will provide necessary guidance to the students in the laboratory. The post-laboratory video covers the topics of data processing using Excel and four scientific writing training activities. The four scientific writing activities include academic integrity, search for scientific literature, citations, APA citation, style, and construction of figures and tables in Excel program. Dr. Lu will assign the students into a group of three. Grouping information will be provided in a separate Excel sheet.

Class Schedule*:* Please refer to the PDF documents "FDST205 Lecture Schedule Spring 2021" and "FDST205 Lab Schedule Spring 2021" and your NWAFU class schedule for detailed times and locations.

REQUIRED MATERIALS AND TECHNOLOGIES:

Textbook: "Food Analysis", 5th edition, S.S. Nielsen, 2017. Springer, New York.

Computer, internet, and scientific calculator

Access to Zoom, Canvas, QQ, and your NWAFU official Email.

Canvas: The Learning Management System for this course will be Canvas (https://canvas.unl.edu). All the grades for exams, quizzes, case study reports, and lab reports will be posted on Canvas. Students will upload their case studies report and lab report on Canvas for grading.

QQ: The QQ group ID for this class is 605565467. The QQ group will serve as a learning platform for getting access to course materials, group discussion, and questions. Students are encouraged to post their questions on the QQ group at any time. The instructor typically replies to students' messages within 24 hours.

Email: Students are also encouraged to communicate with me via email (mlu4@unl.edu).

COURSE DESCRIPTION:

This course focuses on the major constituents of foods, their chemistry, and structures, as well as the chemical methods for the determination and characterization of the food constituents.

COURSE GOALS AND LEARNING OUTCOMES:

Goals:

- Understand and apply critical principles of sample collection, sample preparation, and data evaluation associated with food analysis.
- Understand the chemical properties of major food constituents, including water, proteins, fats, carbohydrates, and minerals.
- Identify the principles, purposes, and applications of techniques to chemically and instrumentally analyze major food constituents.
- Discuss typical analyses associated with quality management of an individual food product, from raw ingredients to final products.
- Identify appropriate methods for chemical and physical characterization of major food constituents.
- Provide chemical and instrumental hands-on laboratory experience for students in the Food Science curriculum while training them to interpret data and writing the laboratory reports scientifically.

Course Learning Outcomes:

- Obtain representative samples of foods and ingredients from bulk lots, and prepare them for analysis.
- Understand the basic chemistry and structures of water, proteins, lipids, carbohydrates, and minerals in foods.
- Demonstrate an understanding of the basic scientific principles associated with each type of food compositional analysis.
- Identify the appropriate methods of analysis to be used based on the investigation purpose (nutrition labeling, quality control, product development, or scientific research) and different food matrices.
- Understand and evaluate the advantages and disadvantages of different analysis methods that can be applied to a specific food.
- Quantitatively express how the strengths and concentrations of acid and base affect the pH and titratable acidity of foods.
- Perform chemical analysis of major food constituents in the lab.
- Analyze experimental data, construct visual representations of data, and write technical lab reports that meet scientific journal standards.
- Improve the scientific writing skills.

EXAMS, QUIZZES, CASE STUDIES, ASSESSMENTS, CHAPTER STUDY QUESTIONS & LAB REPORTS:

Exams: Two closed-book and closed-note on-paper exams will be given. The midterm exam is worth 100 points and only covers the preceding section. The final exam is worth 150 points and is accumulative. On the final exam, 30 points out of 150 points will cover the laboratory section. The format of the questions includes multiple-choices, fill-in-the-blanks, short answers, calculations, and essays. Students need to bring their scientific calculators for the exams. The times and locations of the exams will be announced later.

Quizzes: Four short, and timed quizzes will be given throughout the semester through Canvas. The quizzes are multiple-choice and True-or-False questions. The quizzes will be open-book and open-note. Students are required to work independently on the quizzes. Each quiz will open promptly at the start time 8 am or 9:50 am of the class and close after 15 minutes. Plan to attend all the online classes on time. Students have to keep their cameras on during the quizzes so the instructor can proctor the quizzes. If students missed the quiz without prior notification, students will receive zero points on the missed quiz. The schedule of the quiz is specified in the schedule section of the syllabus. The content of each quiz is based on the associated PowerPoint presentation and assigned textbook chapter.

Case studies: Two case studies will help you relate the course content to realities in the food industry. Discussions on case study questions will be done in class and writing the case study reports will be done in groups after the class. Case studies are more about the discussion between you and your group members than it is about memorizing lecture slides. You must be present on Zoom and actively involved in the small group discussion about the case study. Students will be allowed to self-sign up into a group of 4 students on Canvas. The group case study reports are due 12 days after the in-class discussion through Canvas.

Pre-assessment and post-assessment: There will be a pre-assessment before the start of the course and a post-assessment after the completion of the course. These two assessments do not count towards your total grades. The assessments are used to measure student growth over the semester time and to help the instructor refine the instruction plan in the future. Students will receive 2 bonus points for taking each assessment.

Book chapter study questions: Doing the study questions at the end of the textbook chapters will be important to do well in the course since these questions are typically the basis for quiz and exam questions. Dr. Lu will send students the list of questions after the completion of each chapter. You are not asked to submit the answers to the study questions for credit. However, if you have questions about your response to any of the study questions, you are welcome to ask questions during office hours. You can also contact the instructor through QQ or email for questions.

Lab reports: Formal laboratory reports will be required for the eight experiments. Students will submit a group lab report one week after the completion of the lab exercise. Please type your lab reports in Microsoft Word or a similar program. Late reports will be deducted 1 point per day. The lab report is intended to improve your scientific writing skills in English. A student teaching assistant (TA) with a minor in English major at UNL will grade your English writing skills. Please pay attention to the

use of correct English grammar and the use of scientific writing style. Dr. Lu will provide instructions on how to write scientific reports in the first week of the laboratory section.

GRADING:

The final course grade will be determined based on the percentage of points earned from the two exams, quizzes, and homework.

Midterm Exam – 100 points

Final Exam – 150 points (including 30 points covered the laboratory session)

4 Quizzes – 8 points/each, 32 points

2 Case studies – 10 points/each, 20 points

8 Laboratory reports – 18 points/each, 144 points

Total – 446 points

The following grading scale will be used to determine final grades as listed:

97 - 100% A+	92 – 96.9% A	90 – 91.9% A-
88 – 89.9% B+	82 – 87.9% B	80 – 81.9% B-
78 – 79.9% C+	72 – 77.9% C	70 – 71.9% C-
68 – 69.9% D+	62 – 67.9% D	60 – 61.9% D-
<60% F		

COURSE APPROACH AND REQUIREMENTS:

- Emphasis will be placed on learning and understanding the lecture material. The textbook readings and possible additional readings will be required.
- The instructor is committed to offering a course that maintains an atmosphere of ethical behavior, individual integrity, and equitable treatment of each person. Expression of ideas from various perspectives is encouraged and acknowledges the dignity of all class members.
- Behaviors that disrupt other students' learning are not acceptable and will be addressed by the instructor. All students will show respect toward all others, and act in a courteous manner.
- **Lecture PowerPoints and laboratory manuals will be posted in the QQ group at least two days before the scheduled class times**. Students are responsible for downloading and studying all lecture materials.

CLASSROOM POLICIES:

<u>Attendance/Engagement:</u>

You will be expected to engage online each week. I understand that there may be exceptional circumstances that prevent you from participating. If that happens, let me know at least 48 hours before the absence of the class, and I will work with you.

Policy for late work:

Late work will receive a late point deduction. One point per late day will be deducted from the total point.

PARTICIPATION NOTICE:

Dr. Lu has an on-going attempt to develop new and better methods for promoting student learning and this course is part of the UNL Peer Review Teaching Project. The ultimate goal is to improve Dr. Lu's teaching effectiveness and students' learning outcomes. Dr. Lu will assess the syllabus, exams, in-class activities, quizzes, pre-and post-assessments, and surveys from this course to assess student learning. Student names will not be associated in any way with the final report of this project.

STATEMENT OF ACADEMIC INTEGRITY:

Academic honesty is essential to the existence and integrity of an academic institution. The responsibility for maintaining that integrity is shared by all members of the academic community. To further serve this end, the University supports a Student Code of Conduct that addresses the issue of academic dishonesty.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES:

The University strives to make all learning experiences as accessible as possible. If you anticipate or experience barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can discuss options privately. To establish reasonable accommodations, I may request that you register with Services for Students with Disabilities (SSD). If you are eligible for services and register with their office, make arrangements with me as soon as possible to discuss your accommodations so they can be implemented in a timely manner. SSD contact information: 117 Louise Pound Hall. 402-472-3787

NON-DISCRIMINATION:

It is the policy of the University of Nebraska to not discriminate on the basis of age, gender, sexual orientation, disability, race, color, religion, veteran's status, or national or ethnic origin in its educational programs. The faculty of the College of Business Administration and Department of Management strongly support this policy. If you feel that you have been subjected to some form of discrimination, please contact me immediately or the Department Chair, Dr. Dennis Duchon.

RESOURCES FOR STUDENTS SEEKING MENTAL HEALTH HELP:

UNL offers a variety of options to students to aid them in dealing with stress and adversity. Visit https://caps.unl.edu/ for more information.

FDST205 Food Composition Analysis, Spring 2021
Lecture Schedule for Class 1901-1903
(All the lectures will be taught synchronously through Zoom. Date and Time refer to Beijing Time.)

Week	Date	Class periods	Chapters on Food Analysis textbook 5th Edition	Activities	Chapter Study Question	Office Hours (Live on Zoom)
1	03/06/2021	1-2	Ch 1 Introduction to Food Analysis	**Pre-assessment due on 03/08/2021 (no credit)** **Informed Student Consent Statement Form (Voluntary, no credit)**	Ch 1	
2	03/13/2021	1-2	Ch 5 Sampling and Sample Preparation		Ch 5	**12:30 – 1 pm**
3	03/20/2021	1-2	Ch 15 Moisture and Total Solid Analysis part 1	**Quiz 1, 8 am to 8:10 am**	Ch 15	
4	03/27/2021	1-2	Ch 15 Moisture and Total Solid Analysis part 2			**12:30 – 1 pm**
6	04/10/2021	1-2	Ch 16 Ash Analysis	**Case study 1 Discussion in class** **Case study 1 Report due on 04/21/2021**	Ch 16	
7	04/17/2021	1-2	Ch 22 pH and Titratable acidity	**Quiz 2, 8 am to 8:10 am**	Ch 22	
8	04/24/2021	1-2	Ch 22 pH and Titratable acidity			**12:30 – 1 pm**
10	05/09/2021	1-2	**Midterm exam, 100 points (1-1.5 hours)** **Close-book, On-paper Exam**	**Mid-semester survey (no credit)**		
11	05/15/2021	1-2	Ch 17 Fat Analysis		Ch 17	
12	05/22/2021	1-2	Ch 23 Fat Characterization			**12:30 – 1 pm**
13	05/29/2021	1-3	Ch 18 Protein Analysis Part 1	**Quiz 3, 8 am to 8:10 am**	Ch 18	
14	06/05/2021	1-3	Ch 18 Protein Analysis Part 2	**Case study 2 Discussion in class** **Case study 2 Report due on 06/16/2021**		**10:30 – 11 am**
15	06/07/2021	3-5	Ch 19 Carbohydrate Analysis Part 1	**Quiz 4, 9:50 am to 10 am**	Ch 19	
16	06/19/2021	1-3	Ch 19 Carbohydrate Analysis Part 2			**10:30 – 11 am**
	06/28/2021		**Final Exam, Comprehensive, 150 points (2 hours)** **Close-book, On-paper Exam**	**Post-assessment due on 06/21/2021 (no credit)** **End-of-semester survey (no credit)**		

FDST205 Food Composition Analysis, Spring 2021

Laboratory Schedule for Class 1901

(Students will take the hands-on laboratories in the College of Food Science and Engineering Building on NWAFU campus. Date and Time refers to the time zone in Beijing, China)

Week	Experiment Date	Lab Report Due Date (Due at 11:59 pm)	Laboratory Topics	Writing Activity	NWAFU Faculty	NWAFU Lab Space & Lab Tech
3	03/15/2021	03/22/2021	Lab 1 A. Proper use of volumetric glassware and mechanical pipettor; B. Accuracy and precision assessment; C. Data handling – Computer lab Excel exercise.		Dr. Wenzhi Tang	C415 Lu Cui
4	03/22/2021	03/29/2021	Lab 2 A. Careful use of analytical balance; B. Preparation of samples	1. Academic integrity and the use of database		C417 Li Jiang
5	03/29/2021	04/05/2021	Lab 3 A. Moisture content determination; B. Water activity; C. Ash content determination	2. Citations and APA style		C417 Li Jiang
7	04/12/2021	04/19/2021	Lab 4 A. Preparation and standardization of acid and base solution; B. Determination of acetic acid in vinegar; C. Titratable acidity	3. Construct and label figures		C415 Lu Cui
8	04/14/2021	04/23/2021	Lab 5 Protein content determination: A. Kjeldahl method; B. Automatic Kjeldahl method	4. Construct and label tables		Staff in the Test Center
9	04/26/2021	05/03/2021	Lab 6 Crude fat content determination: A. Soxhlet method; B. Automatic Soxtec method		Dr. Chunxia Xiao	C415 Li Jiang
10	04/28/2021 (class period 11th – 13th, 7:30 pm – 9:40 pm)	05/07/2021	Lab 7 Fat characterization: A. Peroxide value; B. Free fatty acid content			C415 Lu Cui
11	05/10/2021	05/17/2021	Lab 8 A. Color reactions of carbohydrates; B. Refractometry			C417 Li Jiang

FDST205 Food Composition Analysis, Spring 2021
Laboratory Schedule for Class 1902

(Students will take the hands-on laboratories in the College of Food Science and Engineering Building on NWAFU campus. Date and Time refers to the time zone in Beijing, China)

Week	Experiment Date	Lab Report Due Date (Due at 11:59 pm)	Laboratory Topics	Writing Activity	NWAFU Faculty	NWAFU Lab Tech & Lab Space
3	03/16/2021	03/23/2021	Lab 1 A. Proper use of volumetric glassware and mechanical pipettor; B. Accuracy and precision assessment; C. Data handling – Computer lab Excel exercise.		Dr. Chunxia Xiao	C415 Lu Cui
4	03/23/2021	03/30/2021	Lab 2 A. Careful use of analytical balance; B. Preparation of samples	1. Academic integrity and the use of database		C417 Li Jiang
5	03/30/2021	04/06/2021	Lab 3 A. Moisture content determination; B. Water activity; C. Ash content determination	2. Citations and APA style		C417 Li Jiang
6	04/06/2021	04/13/2021	Lab 4 A. Preparation and standardization of acid and base solution; B. Determination of acetic acid in vinegar; C. Titratable acidity	3. Construct and label figures	Dr. Zhifei Chen	C415 Lu Cui
7	04/13/2021	04/23/2021	Lab 5 Protein content determination: A. Kjeldahl method; B. Automatic Kjeldahl method	4. Construct and label tables		Staff in the Test Center
8	04/20/2021	04/27/2021	Lab 6 Crude fat content determination: A. Soxhlet method; B. Automatic Soxtec method			C415 Li Jiang
9	04/27/2021	05/07/2021	Lab 7 Fat characterization: A. Peroxide value; B. Free fatty acid content		Dr. Chunxia Xiao	C415 Lu Cui
11	05/11/2021	05/18/2021	Lab 8 A. Color reactions of carbohydrates; B. Total Carbohydrate; C. Refractometry			C417 Li Jiang

FDST205 Food Composition Analysis, Spring 2021
Laboratory Schedule for Class 1903

(Students will take the hands-on laboratories in the College of Food Science and Engineering Building on NWAFU campus. Date and Time refers to the time zone in Beijing, China)

Week	Experiment Date	Lab Report Due Date (Due at 11:59 pm)	Laboratory Topics	Writing Activity	NWAFU Faculty	NWAFU Lab Tech & Lab Space
3	03/19/2021	03/26/2021	Lab 1 A. Proper use of volumetric glassware and mechanical pipettor; B. Accuracy and precision assessment; C. Data handling – Computer lab Excel exercise.		Dr. Chunxia Xiao	C415 Lu Cui
4	03/26/2021	04/02/2021	Lab 2 A. Careful use of analytical balance; B. Preparation of samples	1. Academic integrity and the use of database		C417 Li Jiang
5	04/02/2021	04/09/2021	Lab 3 A. Moisture content determination; B. Water activity; C. Ash content determination	2. Citations and APA style		C417 Li Jiang
6	04/09/2021	04/16/2021	Lab 4 A. Preparation and standardization of acid and base solution; B. Determination of acetic acid in vinegar; C. Titratable acidity	3. Construct and label figures	Dr. Jing Zhang	C415 Lu Cui
7	04/16/2021	04/23/2021	Lab 5 Protein content determination: A. Kjeldahl method; B. Automatic Kjeldahl method	4. Construct and label tables		Staff in the Test Center
9	04/30/2021	05/07/2021	Lab 6 Crude fat content determination: A. Soxhlet method; B. Automatic Soxtec method		Dr. Chunxia Xiao	C415 Li Jiang
10	05/07/2021	05/14/2021	Lab 7 Fat characterization: A. Peroxide value; B. Free fatty acid content			C415 Lu Cui
11	05/14/2021	05/21/2021	Lab 8 A. Color reactions of carbohydrates; B. Total Carbohydrate; C. Refractometry			C417 Li Jiang

APPENDIX B. RUBRICS FOR SCIENTIFIC WRITING SECTION

Scoring Criteria	Excellent	Fair	Poor
Answers MUST be typed in a font size of 12 points; use Times New Roman and black color; use single space for this lab report.	0.5	0.25	0
The organization of the answers is logical, uses a compelling progression of ideas, and is easy to read.	0.5	0.25	0
The sentence structure is generally correct with few grammar mistakes and minimal punctuation errors.	0.5	0.25	0
Effective data representation using Tables and Figures.	0.5	0.25	0
All information has a trusted source, which needs to be peer-reviewed journal articles (in English) in common SCI databases.	0.5	0.25	0
In-text citations and reference lists are in the correct format (e.g., APA style)	0.5	0.25	0

APPENDIX C. SAMPLE OF STUDENT CASE STUDY REPORT

The following is a sample case study report from a group of 3 students. This group received 10 points for the case study report.

1. What likely caused the problem? (2 pts)

Answer: Grain moisture content is an important index to evaluate grain quality and a basic item for grain detection. Grain moisture content is necessary to maintain life and maintain its inherent good and edible quality. However, excessive grain moisture content is not conducive to grain storage, can lead to heat, mildew, decay and germination.

(1). During the production:Insufficient drying time during production. The product does not reach the target humidity when it is packed into a large container. It's possible that the water content is already over the limit before it gets into a larger container.

(2). During the transportation:High humidity in the air and the cereal has water-absorbing properties. Due to the sealing is not tight lead to cereal absorption, so moisture content rises.

(3). In the packing process：Waiting too long for packaging or being exposed to air for too long during the packaging process causes cere to absorb water.

(4). The relative humidity of the environment is greater than the equilibrium relative humidity of the food and the water vapor diffuses to the food through the packaging material.

2. What questions will you ask? (2 pts)

Answer: (1). Question 1: The changing environmental conditions have complicated effects on the moisture content of food in packaging, and thus how to mitigate this effect?

(2). Question 2: How to reduce the moisture transferring in the packaging content, so as to find suitable packaging materials?

(3). Question 3: Compared with the single component food, which only considers the influence of external water through the package, the water diffusion of multi-component food needs to consider more factors. Not only external water will enter the interior through the package, but also water diffusion will occur between multi-component food due to the presence of water activity gradient. So how to reduce the transfer of water inside the food?

(4). Question 4: How to reduce the transfer of moisture from the inner surface of the packaging material to the surface of the food?

3. What will you do? (i.e., will you shut down the packaging lines? What will the company do in the future?) (2 pts)

Answer: (1). First of all, let's see how much profit we will lose if we close the packing line or improve the packing line. If improving the packaging production line will reduce the loss, I will not close the packaging production. If closing the packaging line can reduce the loss, I will shut down the packaging line.

(2). I think the company could use some ovens to heat the grain product, or let the grain dry in the sun to reduce the moisture of the product. Also, they can change the type of transportation according to the characteristics of grain products, using the track with rain, dust, refrigeration, heat preservation and other facilities. Closing the production line will result in thousands of workers laid off, the company will not be profitable, which will cause a huge crisis, further lead to a series of economic crises, such as the fall of stock prices, and if serious, the company will fail. Therefore, we should take the right way to improve the production line rather than stop production.

4.Why is moisture analysis important in cereal products? (2 pts)

Answer: First, moisture is one of the important quality indicators. A certain moisture content can maintain food quality, prolong food preservation, all kinds of food water have their own standards, sometimes if the moisture content exceeds or decreases by 1, both in quality and economic benefits play a great role. Milk powder, for example, requires water of 3%~5%. If it is 4%~6%, that is, water increases to more than 3.5%, it will cause milk powder to caking, then the commodity value will be low, milk powder will change color and storage period will decrease. Vegetable water content 85%~91%, fruit 80%~90%, fish 67%~81%, eggs 73%~75%, milk 87%, pork 43%~59%. In terms of moisture content, the moisture content of food affects the flavor, spoilage and mildew of food, and at the same time, many physical properties change after dry food and moisture absorption. Second, an important economic indicator. The food factory can balance the material according to the moisture content in the raw material.Third, the content of water is closely related to the growth of microorganisms and biochemical reactions. In general, control moisture a little lower to prevent microbial growth, but not the lower the water, the better. Microorganisms usually act more strongly than biochemistry. The importance of moisture determination can be explained from the above three points. Moisture is a must in our food analysis. (N. G. 2021)

Reference (0.5 pt):

Fayi. H. “Study on Shelf-life of Multi-component Food Moisture-proof Package.” Light Industry Handicraft Industry (2016): https://wap.cnki.net/touch/web/Journal/Article/ZGSP200704026.html.

N. G., et al. “The Significance of Determination of Moisture in Food Industry” http://www.jingtaiyiqi.cn/faq/faq50.html. 21 February 2021

APPENDIX D. SAMPLE OF STUDENT LAB REPORT

A sample lab report 2 is shown below in the picture format in order to show the comments from the instructor and TA. The highlighted (in yellow) questions were graded using the scientific writing rubrics. This lab report received full score of 18 points.

Lab 2A. The ProperUse and Care of an Analytical Balance

1. Report the weights of the glass object obtained before and after cooling in Table 1. How do the weights compare? What is responsible for any difference observed? (1 pt) Why should hot objects not be weighed on an analytical balance use diagram if desired? (1 pt)

Table 1 for Effect of Temperature on the Apparent Weight of a Sample (0.5 pt)

Object	Weight (g)
Hot beaker	51.1588
Cool beaker	51.1796

1

Very good!

According to the data in Table 1, the weight of the cold beaker is greater than that of the hot beaker. First, the measurement error can be caused by air buoyancy. The hot beaker generates air flow in the analytical balance, and the air flow will buoy up the weighing pan, which causes the weight of the hot beaker to be less than that of the cold beaker. Second, during the cooling process of the beaker from hot to cold, the air in the beaker is also cooling down. The volume of the air is fixed, but the density of the hot air is less than that of the cold air. Therefore, the mass of the air in the beaker is also increasing, and the number of the balance is also increasing.

First, overheated objects will damage the analytical balance, reduce the lifetime of the balance and affect the accuracy of the measurement. Second, after heating, the air density becomes smaller and the air rises. The flowing air makes the analytical balance unstable, which leads to the instability of the measured data. Therefore, the object weighed by the analytical balance should be restored to room temperature.

2. Report the changes in weights observed as the cucumber sample was exposed to the air in Table 2, and describe what is happening (1 pt). What would you expect to happen if a very dry sample such as milk powder was exposed to the air for the same length of time? Why? (1 pt)

Table 2 Effect of Moisture Loss on the Apparent Weight of a Sample (1 pt)

Cucumber cubes	Weight (g)
At time 0 min	5.0819
After 1 min	5.0786
After 2 min	5.0751
After 3 min	5.0718

With the exposure time increasing, the free water in the cucumber sample evaporated, so the weight of the sample decreased. When a very dry sample is exposed to the air, its weight would increase with time passing. This is because the powder absorbs water from the air, which increases the weight of the sample. The moisture content of different samples is different, which leads to the increase or decrease of sample weight, so it is important of us to weigh sample as quickly as possible.

3. Report the weights obtained in Table 3 when using the weighing by difference technique. Calculate the weights of the three portions of salt respectively. How can weighing errors due to buoyancy effects occur? (0.5 pt) How does using the weighing by difference technique help to avoid such errors? (0.5 pt)

Table 3 for Weighing by Difference Technique (1 pt)

Weight Measurements	Weight (g)

2

Weighing bottle with all salt	22.1791
Weighing bottle with ~ 2/3 salt	21.7766
Weighing bottle with ~ 1/3 salt	21.2282
Weight of empty weighing bottle	20.6812

Calculations (1 pt)**:**
Weight of the first portion of salt: = 22.1791-21.7766 = 0.4025(g)

Excellent for showing the calculations!

Weight of the second portion of salt: = 21.7766-21.2282 = 0.5484(g)

Weight of the last portion of salt: = 21.2282-20.6812 = 0.5470(g)

~~When the salt was transferred from the bottle to the beaker, buoyant force made the air buoy up the weighing pan, which increased weighing errors.~~ Furthermore, the sample in containers of different sizes and densities would lead to inaccurate measurement.

When difference technique was used to weigh the sample, the container did not change, and the weight of the sample poured out was calculated by subtraction, which avoided the influence of different buoyancy caused by the changing of container on the measurement. Therefore, it is useful to use difference technique to reduce errors. Good!

Lab 2B. Preparation of Samples

4. Calculate the percentage of white corn kernels in total prepared by coning and quartering, and in the corn prepared using the sampler. How do the results compare with the original percentage of white corn in total labeled on the sample jar? Which technique produced a sample more representative of the bulk material? (1 pt) Which technique was easier and more efficient to use? (0.5 pt) Based on these factors, which technique would you recommend for reducing the sample size of a granular material? (0.5 pt)

Table 4 for Preparation of Samples (1 pt)

Methods for sample size reduction	Weights			% of white corn kernels in total
	White corn kernels (g)	Yellow corn kernels (g)	Total corn kernels (g)	
Coning and quartering	10.4494	50.5731	61.0225	17.1238%
Sample divider	12.9343	55.4209	68.3552	18.9222%

According to the data, the percentage of white corn kernels in total obtained by the sample divider is closer to 20%, which is the data on the sample jar. Therefore, the sample taken from the sample divider was more representative of the bulk material.

The coning and quartering methods are easier to produce errors because of the manual

3

Mei Lyu Apr 3
weighing by difference technique

Mei Lyu Apr 3
Good!

operation, and the speed of sample separation is slow. The sample divider method divides the corn by machine with high efficiency, high speed and uniform sampling. So, the sample divider was easier and more efficient to use. When reducing the sample size of a granular material, the sample divider with high efficiency was more recommendable.

5. After grinding the whole wheat kernels using the cyclone mill, approximately 90% of your ground wheat sample can pass through the 20 mesh sieve. About 90% of the commercial whole wheat flour can pass through 40 mesh sieve. In this case, which flour has a finer particle size? Why? (1.5 pt)

The number of holes in a 1-inch section of a screen is defined as the number of mesh. The smaller the mesh, the larger the particle size of the material; the larger the mesh, the finer the particle size of the material. Therefore, the commercial whole wheat flour which can pass through 40 mesh sieve has a finer particle size. Perfect

6. Read the journal acticle "Impact of flour particle size on nutrient and phenolic acid composition of commercial wheat varieties". Summarize the scientific findings on how particle size affects crude fat content analysis (1 pt). Explain why the particle size of sample impact on the crude fat content analysis. (1 pt) Add this journal article as your referece at the end of the lab report in the following format:

The largest particle size (< 1.18mm - > 0.43mm) obtained lower quantity of crude fat in all kinds of wheat. ~~And~~, among the three varieties, the total crude fat content of different types of flour with the particle size between 0.3 mm and 0.43 was the highest. When the particle size of flour was less than 0.3mm, the content of crude fat decreased with the decrease of the particle size.

The smaller the particle size, the larger the surface area, which leads to the improvement of fat extraction efficiency. When the flour particle size was between 0.3 mm and 0.43 mm, the high content of crude fat was due to the abundance of germ part. When the particle size was less than 0.3 mm, abundant starchy endosperm part in these kinds of wheat may be the main reason for the decrease of crude fat content.

Author, A. A., Author, B. B., & Author, C. C. (Year). Title of article. *Title of Journal, volume number*(issue number), pages. https://doi.org/xx.xxx/yyyy (Format: Title of Journal and volume are both italicized. The hanging indent is 1.27 cm or 0.5 inch)

Reference:

Memon, A.A., Mahar, I., Memon, R., Soomro, S., Harnly, J., Memon, N., Bhangar, M.I., & Luthria, D.L.~~(PhD)~~ (2020). Impact of flour particle size on nutrient and phenolic acid composition of commercial wheat varieties. *Journal of Food Composition and Analysis, 86(103358)*, 1-8. ~~www.elsevier.com/locate/jfca~~

PAGE 4 5

Mei Lyu Apr 3

Perfect

Madyson DeJoy Apr 1

take out or replace with Furthermore

Mei Lyu Apr 3

In this course, you could remember this general rule for the purpose of exams and quizzes.

Mei Lyu Apr 3

Delete

Mei Lyu Apr 3

https://doi.org/10.1016/j.jfca.2019.103358